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ABSTRACT

This paper identifies characteristics of a "good" programming teacher, derived from a study of four teachers in charge of beginning courses in BASIC programming language at high schools in the Greater Kansas City area. In addition to doing classroom observation, the researcher interviewed the teachers themselves, students, and the teachers' immediate supervisors. Results are discussed in terms of: (1) special personal qualities like patience, responsiveness, and enthusiasm, exhibited by the teacher in the classroom; (2) criteria offered through questionnaire responses from district coordinators, from 20 programming teachers described by those coordinators as effective, and from the students of the four particular teachers being studied; and (3) the programming concepts, problem-solving skills, and teaching strategies emphasized by each of the observed teachers. Tables illustrate criteria mentioned in the questionnaires and the degrees to which teachers stressed certain concepts and skills. (Author/BEW)

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Characteristics of a Good Programming Teacher

by Barbara Kushan, S.C.L.

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paper

Characteristics of a Good Programming Teacher

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Abstract

This paper presents characteristics of a "good" programming teacher derived from a study of four programming teachers at the high school level. Results are discussed in relation to: (a) characteristics demonstrated by the teachers in the classroom; (b) criteria for effective computer teachers gathered from district coordinators, computer teachers, and students; (c) summary of (i) programming concepts emphasized, (ii) problem-solving strategies emphasized, and (iii) teaching strategies used.

Paper

Having taught programming at the high school level for seven years and at the college level for 15 years, I became interested in the concept of what makes for a "good" programming teacher. In the Midwest, I would always run into teachers who would say, "I can teach BASIC in two weeks," and I knew that I was spending two semesters or a whole year to teach BASIC. Then, one day it finally hit me: "I wasn't just teaching BASIC; I was teaching programming techniques and problem solving, as well." Many of my students would go on to major in computer science or into careers in other fields using computers because of the one course they took from me.

So, when I received a sabbatical year from teaching, I decided to study a group of high school teachers to find the characteristics of a "good" programming teacher. A metropolitan area in the Midwest offered an excellent setting for my study. The Greater Kansas City area encompassed 20 school districts (12 in Missouri and 8 in Kansas) with 50 high schools which include inner-city, urban, and suburban. Four teachers who taught a beginning BASIC programming course the year of

the study were selected as my subjects for the study. Selecting the four teachers based on their variation in degree of computer preparation, site of teaching, and gender provided for information-rich samples and provided some interesting results.

The concepts of programming and problem solving that these teachers stressed and the teaching strategies they used in teaching BASIC programming to novice programmers were examined from three perspectives: the teacher, the teacher's supervisor, and the students. Data collection instruments included: questionnaires, observations, interviews, and classroom documents. Each teacher was observed for one unit or chapter (three to four weeks). This meant consecutive daily observations of one class. All aspects of teaching a single unit: the teacher's handling of lectures (large and small groups), laboratory supervision (individual and teacher interaction), assignments, grading, and testing were part of the study. Interviews were conducted with each teacher, the immediate supervisor, and several students in each class. Any classroom document pertaining to teaching the programming course was examined. Information gathered about each of the teachers provided several characteristics of a successful programming instructor.

Special Characteristics of Each Teacher Studied

After observing each teacher for three to four weeks, I described each teacher using two to three descriptive words about their approach to teaching programming. Two words that describe Gene (teaching in Kansas with most coursework) are *questioning* and *patient*. Throughout the three weeks of observation, Gene consistently helped his students reach an understanding of the material by asking them questions to help them answer their own questions. He would patiently wait for them to think and arrive at an answer or ask another question to lead them to the right answers. Larry, one of Gene's students, explained it this way. "When he's having us write a program on the overhead–when he's writing it–he'll ask us what the next line is. If we don't give him the right answer, then he'll question us and make us think about it." It would have been so much faster to give the students the answer, but Gene wanted all of them to stay with the thinking process in order to understand the material.

Two words that describe Leigh (teaching in Missouri with most coursework) are *understanding* and *responsive*. The word, understanding, characterizes Leigh in the way he treated students and by what he desired students to get from his class. He always treated each student with kindness. Throughout the three weeks of observation, Leigh consistently encouraged his students to strive to understand the material. Although he worked with students who did not value education as much as students in the other schools, he was responsive to the needs of each student, his second characteristic. Approaching the students individually, he accommodated each one according to need and depending upon the situation at that time. He wanted his students to see the importance of really understanding what they were doing and to develop their thinking skills.

Three words that describe Kathy (teaching in Kansas with least coursework) and her classroom are *practice*, *fun*, and *equity*. Kathy's theme in the classroom was, "Practice makes perfect." She followed every lecture with an immediate assignment to practice the concepts previously explained, to be done either in class or at home. She had the students correct their own papers the next day for immediate feedback. One might think that high school students today wouldn't like doing all this work, but Kathy's students described her and her class as "fun." Kathy kept a light atmosphere in the classroom. Throughout the four weeks of observation, she consistently treated her students with respect and fairness even though five of the students were absent quite often. These attitudes helped each student in her class think and feel that they were learning something–something important.

Two words that describe Mary (teaching in Missouri with least coursework) are *dynamic* and *affirming*. Dynamic describes Mary in three ways: (a) she is a lively, vibrant force in the classroom; (b) she makes the computer field living and current to her students; and (c) she is ever adapting her teaching approach to meet the needs of her varied students. Praising her students for the tasks that they accomplish and affirming their efforts, Mary motivates and challenges with a positive approach. These characteristics of Mary are key to her enthusiastic effect on her students.

Criteria of Effective Computer Teachers

Based on these observed characteristics, one might say a "good" programming teacher is questioning, patient, understanding, responsive, fun, equitable, dynamic, affirming. But, it might be difficult to find one teacher who embodies all these qualities. So, next I examined criteria of effective computer teachers given by: the district coordinators who identified their best computer teachers, the computer teachers who were described as effective and who responded to the questionnaire, and the students of the four teachers who were the subjects of the main study. The criteria are listed from most frequently mentioned to the least. These are given in a table for each group and then summarized into a composite picture.

District Coordinators' Perspective

The district coordinators, who are the computer coordinators or the curriculum coordinators, from the 20 districts in the Greater Kansas City area were contacted by phone. Each coordinator was asked to submit the names of one to five (depending on the size of the district) high school teachers whom they considered effective computer teachers. Table 1 summarizes the criteria given by the 20 coordinators. Only two items, "knowledge of the subject" and "get good results," are mentioned by more than half of the coordinators. All the criteria are listed to show the variation in districts in one metropolitan area. It is important and possibly sad to note that only one coordinator mentioned, "Teach students to think."

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Table 1. Criteria of Effective Teachers Given by District Coordinators

Criteria	Frequency
Knowledge of the subject	12
Get good results *	10
Good rapport with students	9
Keep up-to-date	7
Help develop curriculum	6
Enrollment increase or stable	5
Innovative, vision the future	4
Experience of working with them	4
Enthusiastic	3
Use various teaching strategies	3
Develop student interest	3
Good performance evaluation	2
Experienced teacher	2
Respected by colleagues	2
Train other teachers	2
Cooperative	2
Good communication skills	2
Lots of energy	1
Teach at a college	1
Teach students to think	1
Manage classroom behavior	1
Patience	1

*Get good results includes: what students are able to produce, grades students merit, and percentage of students who obtain advanced placement.

Computer Teachers' Perspective

Questionnaires were mailed to the 60 teachers, described as "effective" by their coordinators. These teachers from 40 different schools were asked to provide various demographic data and to state the characteristics they would attribute to an effective computer teacher. Twenty-two teachers responded to the questionnaire, but only 20 teachers answered this specific question. Table 2 summarizes the criteria given by the 20 computer teachers who had been deemed effective by their district coordinators. No item is mentioned by a majority of the teachers. However, the wide range shows that the teachers looked closely to identify the characteristics that make an effective computer teacher rather than simply listing criteria found in an educational textbook. The comments indicate that most of the criteria came from self-inspection. Also noteworthy, is the fact that four of the teachers considered the criteria, "effectively teach problem solving," as important for an effective teacher.

Table 2. Criteria of Effective Teachers Given by Computer Teachers

Criteria	Frequency
Knowledge of the subject	7
Flexible–work with varying abilities	7
Seeks self-improvement, keep up-to-date	5
Patience	5
Effectively teach problem solving	4
Able to communicate well	4
Help students become self-motivated	3
Creativity	3
Deep interest in the subject	3
Positive and reaffirming	2
Truly cares	2
Works hard and long hours	2
Enthusiasm	1
Ability to organize	1
Ability to work with those doing various tasks	1
Always moving about the room helping	1
Let students learn by mistakes	1
Like teaching	1
Humor	1
Attention to detail	1

Appreciate computer ethics	1	
Use cooperative learning	1	

Students' Perspective

The student perspective on what makes an effective computer teacher was also sought. Three to five students from the classes of the four teachers who were the subjects of the main study were interviewed. Each student was asked, "What characteristics would you attribute to an effective computer teacher?" If a student had trouble responding to this question, he or she was asked, "How would you describe a 'good' teacher to a friend?" Every student was able to respond to one of these questions.

Table 3 summarizes the criteria given by the 16 students. Only two items are mentioned by more than half of the students: "helpful" (10 students) and "teaches you, explains well" (9 students). Although most items are only mentioned once by one student, all of them might be of interest to computer teachers.

Table 3. Criteria of Effective Teachers Given by Students

Criteria	G (4)	L (4)	K (5)	M (3)
Helpful	3	3	2	2
Teaches you, explains well	2	3	2	2
Makes sure you understand	1	2	2	
Knowledge of the subject	2			2
Good rapport with students	1	1	1	1
Ability to communicate with the students	1	1	1	1
Jokes, is fun			2	
Patience		1		
Makes us practice a lot				1
Well-organized	1			
Interesting	1			
Shows how to apply to life				1
Spends time after school			1	
Stresses doing things on your own		1		
Makes you earn your grade			1	
Outgoing		1		
Understands and fosters different rate students learn				1

The three sets of criteria are examined for common themes. The intent is to look at those criteria that are mentioned by the majority in each group; however, in the teachers' list, no item is mentioned by the majority. Since there are two such items in each of the other groups, the top two criteria from the teachers' list are used to examine common themes. "Helpful" in the students' list was grouped with "flexible–work with students with varying abilities," the second item in the teachers' list. The common criteria that resulted are: (a) knowledge of the subject; (b) helpful, flexible–work with students with varying abilities; (c) teaches, explains well; and (d) get good results. "Get good results" included what students are able to produce, grades that students merit, and percentage of students who obtain advanced placement.

Concepts and Strategies Emphasized by the Four Teachers

In the final analysis, the teaching activities of the four teachers were examined using the list of concepts and strategies gleaned from a search of the literature and through discussions with computer educators at the college and high school level. (See the article, "Teaching Programming and Problem-Solving Strategies in High School Courses Today: A Case Study," (Kushan, 1993) for a detailed description of these concepts and strategies.)

The programming concepts, problem-solving strategies, and teaching strategies emphasized by the four teachers were determined through the observations, teacher interviews, supervisor interviews, and student interviews. The presence of a concept or strategy in the classroom of each teacher was rated high, medium, low, or none. A high (H) rating means that the concept or strategy was noticed several times during the observation and was found in the data from three or more instruments. A medium (M) rating means that the concept or strategy was noticed several times during the observation but was found in the data from only two instruments. A medium rating was also given if one aspect of a concept or strategy was missing in that teacher's presentation. A low (L) rating means that the concept or strategy was noticed only a few times or was found in data from only one instrument, for example, the teacher interviews. A rating of none (N) means that the concept or strategy was not present in the data from any instruments, not even the teacher interviews. The degree of emphasis of each of the concepts is given in the tables with the concepts or strategies listed vertically and the teachers' pseudo-names listed horizontally. The entries in the table are the ratings of presence of each particular concept or strategy in a teacher's classroom. The rating for each teacher was a judgment by the researcher based upon all the information gathered.

Programming Concepts Emphasized

Table 4 shows which programming concepts were emphasized in the programming classes of the four high school teachers (Gene–G; Leigh–L; Kathy–K; and Mary–M). A concept was considered emphasized if two or more teachers had

ratings of medium or high for their emphasis level. Eight (marked with >) of the 12 programming concepts listed as important were considered emphasized and ranked according to overall emphasis by all four teachers: (a) syntactic knowledge, (b) semantic knowledge, (c) modularity, (d) structured programming, (e) internal documentation, (f) top-down design, (g) debugging, and (h) external documentation (design tools).

Table 4. Degree of Emphasis of Programming Concepts

	G	L	K	M
Structured Programming	H	L	M	H
Top-down Design	L	L	M	H
Bottom-up Design	N	N	N	N
Modularity	H	M	M	H
Syntactic Knowledge	H	H	H	H
Programming Practices	H	H	H	H
Meaningful Names	M	L	L	L
Initialization	M	N	N	N
Generalization	N	L	L	N
Internal Documentation	H	L	M	H
External Documentation	N	L	M	H
Debugging	H	M	L	L
Testing	L	L	L	L
Maintenance	N	L	M	N

H–High M–Medium L–Low N–None

Because of the importance given to structured programming as an element for success in college computer courses in the Taylor and Mounfield (1991) study and to show how the ratings were assigned on this topic, a step-by-step analysis of the teaching of structured programming by the four teachers follows. Structured programming requires that a program be composed of only the three structures, sequence, decision, and loop, and that every structure be entered only at the beginning and exited only at the end. An emphasis on the use of subprograms and discouraging the use of the GOTO statement in BASIC are signs of structured programming.

The units on arrays taught by the four teachers used the FOR/NEXT loop structure which meets the one-entry/one-exit principle. During large group lectures, Gene and Kathy both reminded the students not to use GOTO statements in their programming projects, but only Kathy made mention of the one-entry/one-exit principle when lecturing on one of the sorting methods.

Gene and Mary required that every program be written with one main routine that called several subroutines. Kathy and Leigh encouraged students to think in terms of modules for inputting data, sorting data, and then printing data. However, Kathy presented a sort module that also printed the results and Leigh's students repeated code for printing the original array and the sorted array rather than writing a subroutine.

Gene and Mary had students clearly mark subroutines with REM statements and indicate loop and decision structures with indentation. Mary indicated that this was an important part of structured programming. She explained, "Also, part of the structured programming would be a lot of the formatting of your program–the loop indentation and the documentation of the REM statements." Kathy stressed indentation of structures to her students but did not require that modules be marked with REM statements. The rating of low was given to Leigh because he did not stress two of the aspects of structured programming.

Problem-Solving Strategies Emphasized

Table 5 shows which problem-solving strategies were emphasized in the programming classes of the four high school teachers. A strategy was considered emphasized if two or more teachers had ratings of medium or high for their emphasis level. Five (marked with >) of the 10 problem-solving strategies were emphasized and ranked according to overall emphasis by all four teachers: (a) selecting the best solution, (b) analytical approach, (c) breaking into smaller steps, (d) re-analysis, and (e) the steps of problem solving.

Table 5. Degree of Emphasis of Problem-Solving Strategies

	G	L	K	M
Steps of problem solving	L	N	M	H
Breaking into smaller stepsM	L	L	H	
Looking for a pattern	N	L	N	N
Using a model	N	N	H	N
Analytical approach	M	L	M	H
Visual approach	L	N	N	H
Selecting the best solution	H	H	M	N
Problem posing	N	L	N	N
Plan composition	L	N	N	N
Re-analysis	H	M	L	L

H–High M–Medium L–Low N–None

Kushan, B. (1993). Teaching programming and problem-solving strategies in high school courses today:: A case study. *Journal of Computer Science Education*, 7(4), 28-34.

Lehrer, R., Guckenberg, T., and Sancilio, L. (1988). Influences of Logo on children's intellectual development. In R. E. Mayer (Ed.), *Teaching and learning computer programming: Multiple research perspectives* (pp. 75 -110). Hillsdale, NJ: Erbaum.

Taylor, H. G., & Mounfield, L. (1991). An analysis of success factors in college computer science: high school methodology is a key element. *Journal of Research on Computing in Education*, 24(2), 240-245.